The Revolution of Shale Gas in the world. What are the opportunities for Latin America?

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In 2008, the rise in oil prices was accompanied—and partly fueled—by a belief that an era of permanent scarcity was at hand. The US was on the way to spending $100 billion a year to import liquefied natural gas (LNG) from West Africa, the Middle East, even Australia and Russia.

Forecasted LNG imports of 35 MM ton/y in 2018 increasing to 100MM ton/y in 2030

Gas prices would increase accordingly to reflect the scarcity of gas and the higher price of imported LNG
Market consensus was that the US and China would be the leading importers of LNG due to depletion of its natural gas reserve base in the case of US and the energy needs of China to fulfill its growth targets.

Based on this assumption the LNG industry developed its liquefaction capacity with the US and China markets as their prime targets. On the other hand the US and China built regasification plants to be able to import increasing quantities of LNG.
But this scenario didn’t turn out to be correct. Technology made the difference. Shale gas and tight oil production changed the picture completely.

In year 2000 shale gas amounted to only about 2% of United States production. Today, it is 37% and rising.

This abundance has ignited a new political argument about LNG—not about how much the US will import but rather how much it should export.

**U.S. dry gas production TCF/year**


**Announced LNG Export Projects**

FID taken in July for a 9 million metric ton (1.2 billion cubic feet per day) LNG Liquefaction plant.
Natural gas price projections are lower consistent with the developments in shale gas production.

The oil story is also being rewritten, U.S. petroleum imports continues to decline.

The biggest part of the increase is coming from “tight oil”. That is the term for oil produced from tight rock formations with the same technology used to produce shale gas.

Source: EIA, Annual Energy Outlook 2012
Furthermore studies show that gas shale formations are widespread throughout the world.

According to EIA 48 Shale gas basins in 32 countries contains almost 70 shale gas formations.
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Shale gas is natural gas located in a more difficult place to be extracted.

Source: http://www.propublica.org/special/hydraulic-fracturing-national
The technology of horizontal drilling greatly improved the productivity of wells and brought down the production cost. Making it happen will require technology and a lot of money: Argentina example in Neuquen (Vaca Muerta).

US Shale gas production in Barnett field

<table>
<thead>
<tr>
<th>Area</th>
<th>Current State</th>
<th>Potential 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Production</td>
<td>&lt;5 kbbd</td>
<td>&gt;50+ kbbd</td>
</tr>
<tr>
<td>Natural Gas Production</td>
<td>nill</td>
<td>2 BCFD</td>
</tr>
<tr>
<td>Annual Wells Drilled</td>
<td>~50 (most vertical)</td>
<td>800+ (most horizontal)</td>
</tr>
<tr>
<td>Fracture Pumping</td>
<td>&lt; 200,000 HHP (about half in Neuquen)</td>
<td>1.5 million HHP</td>
</tr>
<tr>
<td>Drilling Rigs</td>
<td>Total ~100 (few with horizontal capability)</td>
<td>+100 (all horizontal)</td>
</tr>
<tr>
<td>Water Use</td>
<td>Minimal</td>
<td>200 kbd</td>
</tr>
<tr>
<td>Annual Capital Invested</td>
<td>US$ 500 million</td>
<td>US$ 10 billion</td>
</tr>
</tbody>
</table>

Horizontal drilling with hydraulic fracturing increases 1000 times the contact surface between the well and the gas producing rock.
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South America has important gas resources but not evenly distributed and far from consumption centers.

- **Brasil**
  - P1: ~15 Tcf
  - Shale Gas (e): ~226 Tcf

- **Colombia**
  - P1: ~5 Tcf
  - P2+P3: ~4 Tcf
  - Shale Gas (e): ~19 Tcf

- **Chile**
  - P1: ~4 Tcf
  - Shale Gas (e): ~64 Tcf

- **Perú**
  - P1: ~12 Tcf
  - P2+P3: ~31 Tcf
  - Shale Gas (e): ~19 Tcf

- **Uruguay**
  - Shale Gas (e): ~21 Tcf

- **Venezuela**
  - P1: ~179 Tcf
  - Shale Gas (e): ~11 Tcf

- **Bolivia**
  - P1: ~10 Tcf
  - Shale Gas (e): ~48 Tcf

- **Paraguay**
  - Shale Gas (e): ~62 Tcf

- **Argentina**
  - P1: ~12 Tcf
  - P2+P3: ~9 Tcf
  - Shale Gas (e): ~774 Tcf

**Highlights**
- Gas resources in Venezuela mostly associated with oil production
- Connecting resources and consumption centers face big hurdles (Andes, Amazonian forest)
- Development of resources require big long term investments
- Shale gas may be a game changer

**Sources:** local & international agencies
Physical integration has been developed since 1990 as a long term business.

Drivers for Industry development:
- Gas prices < 2 USD/MBTU
- Anchor in Power Generation
- Fuel Substitutions
- Good prices for condensates
- Long term commitments
- Development of new segments of consumption (industrial, transportation, residential)

Drivers for Integrated development:
- Size of Investments
- Value added of diverse Players
- Alignment of interests
- Case of Chile
- Case of Peru

Source: Energy Consulting Services based on local information
And then, LNG integrated the region with a worldwide market.

### Pipelines in South America & Electricity Interconnections

Drivers for further development:
- Shortfalls and Disruptions
- Prices of Energy specially oil
- Environmental, Time to market
- Case of Chile
- Case of Peru

Notes:
- 2011 Volumes Exchanged average (Mcm/d).
- Chile LNG: includes estimations based on Custom House and CDEC-SING information.

Source: Energy Consulting Services based on local information
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Shale gas plays in Latin America are concentrated in four countries so far: Argentina, Brazil, Colombia and Mexico.

To have an idea of scale, the entire Latin America gas market consumed about 5 TCF in 2011.
Shale Gas

Estimated technically recoverable resources

America’s select basins, 2009
(trillion cubic feet)

Proved Natural Gas Reserves
Technically Recoverable Shale Gas Resources

United States: 272.5 Tcf, 862 Tcf
Canada: 62 Tcf, 388 Tcf
Mexico: 12 Tcf, 681 Tcf
Venezuela: 178.9 Tcf, 11 Tcf
Colombia: 4 Tcf, 19 Tcf
Argentina: 13.4 Tcf, 774 Tcf
Brazil: 12.9 Tcf, 226 Tcf
Chile: 3.5 Tcf, 64 Tcf
Bolivia: 26.5 Tcf, 48 Tcf

Production
Consumption

Source: US Energy Information Administration
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Shale and Unconventional gas need long term perspectives

• Shale gas has been a game changer in the US. This could be expanded in other areas of the world

• In the US, the demand side for shale gas developments was not an issue
  – Demand side Infrastructure was in place, and a real market available.
  – Replaced already existing natural gas (and LNG import prospects)
  – Switching from liquids to gas could accelerate even mobile applications (ie Heavy Duty Vehicles).

• Technology developments, hydraulic fracture and directional drilling, made possible to access vast untapped resources widely spread throughout the world.

• In Latin America natural gas sector has been developed in different stages
  – Low gas prices, shortfalls of energy → pipelines
  – High oil prices, new shortfalls of gas → LNG

• Shale and other sources of gas may push a new industry development stage
  – Power Generation can be an anchor as in the past,
  – Condensates leverage may facilitate.

• Large ventures need joint efforts of new and existing players, in addition to framework.
  – The Camisea case as benchmark? An integrated view of gas and liquids
  – Development of infrastructure to link supply and demand
  – Technology transfer barriers have to come down
  – Adequate economic and regulatory conditions with long term view.
  – Development of a complex service industry to be able to tap the potential of unconventional resources

Competitive long term prices → Long term commitments → Long term projects
Thank you for your attention!

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